CliMAF Earth System Model Evaluation Platform

CliMAF
Sharing – Simplifying – Optimizing

Evaluating/comparing a set of simulations/models:
Current status for ORCHIDEE

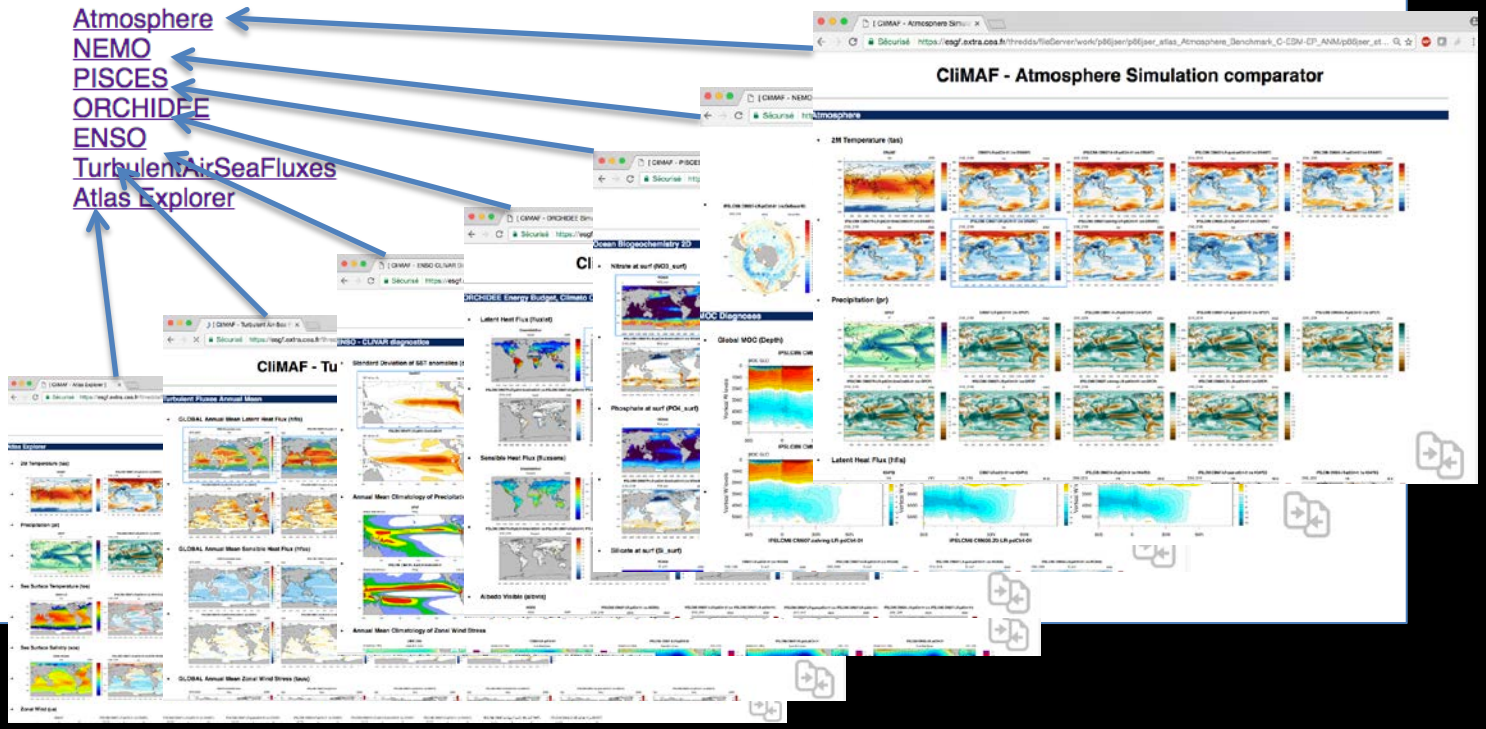
CliMAF Earth System Model E

Sécurisé https://esgf.extra.cea.fr/thredds/fileServer/work/p86jser/C-ESM-EP_Benchmark_C-ESM-EP.html

CliMAF Earth System Model Evaluation Platform

Comparison setup: Benchmark_C-ESM-EP

- Atmosphere
- NEMO
- PISCES
- ORCHIDEE
- ENSO
- TurbulentAirSeaFluxes
- Atlas Explorer



The C-ESM-EP is based on **CliMAF** (http://climaf.readthedocs.io/en/latest/)**,** an advanced python framework developed in collaboration between CNRM-GAME and IPSL to provide the french community with an efficient way to gather-share diagnostics and apply them routinely on the climate models outputs.

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Contact: climaf@meteo.fr

Agence Nationale de la Recherche ANR - MODÈLES NUMÉRIQUES - CONVERGENCE

Main strengths:

- Standardised way to access the data => can be adapted to any CF-compliant netcdf files => encourage sharing the diagnostics!
  ➔ Also a way to standardize your data: different data structures provided to the same diagnostics (alias)
- Automatically manage the output in a smart cache (uses the existing results = avoid recomputation)
- Simplified way to do those daily pretreatments (averaging, period/geographical domain selection, …) based on CDO
- Easy way to do plots (using an NCL script) and put them in an html page
- Plug your own script of diagnostic

The C-ESM-EP in a nutshell

The quick way to use the C-ESM-EP

1. Copy the sources in a working directory:

```
cd my_working_directory
git clone https://github.com/jservonnat/C-ESM-EP.git
or
git clone jservon@ciclad.ipsl.jussieu.fr:~/C-ESM-EP/git C-ESM-EP
```

2. Setup your comparison:

```
cd C-ESM-EP
cp -r comparison_example/ all_components_demo/
```

1. Run all the components together or just a subset:

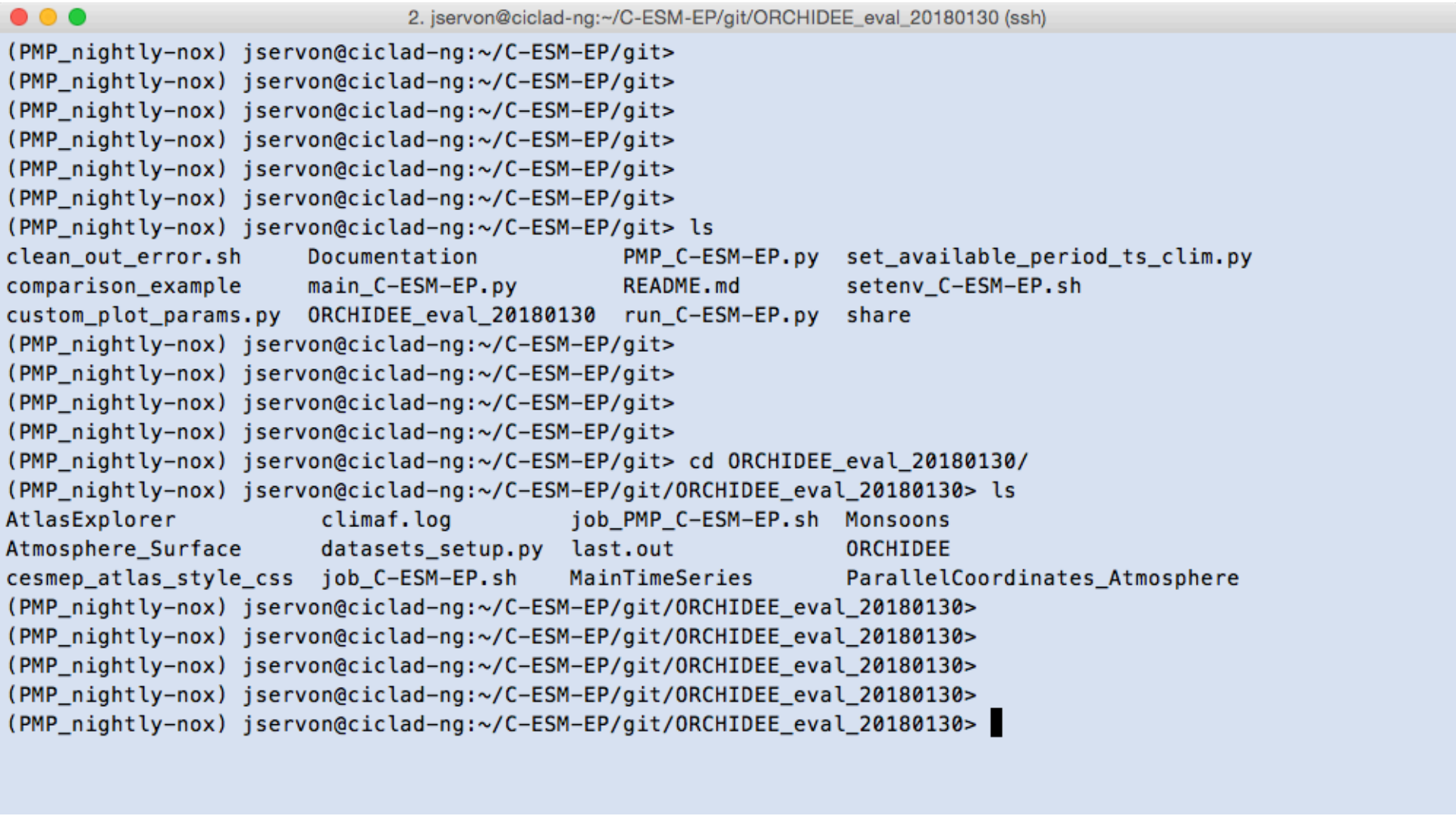
```
python run_C-ESM-EP.py all_components_demo [ORCHIDEE]
```

5. See the results on the URL returned by run_C-ESM-EP.py

```
-- The CliMAF ESM Evaluation Platform will be available here:
--
--   https://vesg.ipsl.upmc.fr/thredds/fileServer/IPSLFS/jservon/C-ESM-EP/all_components_demo_jservon/C-ESM-EP_all_components_demo.html
--
--
-- html file can be seen here:
-- /prodigfs/ipslfs/dods/jservon/C-ESM-EP/all_components_demo_jservon/C-ESM-EP_all_components_demo.html
(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/work>
```

Adding your simulations

datasets_setup.py



Adding your simulations

datasets_setup.py

2. jservon@ciclad-ng:~/C-ESM-EP/git/ORCHIDEE_eval_20180130 (ssh)

```
(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git>
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(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git> ls
clean_out_error.sh     Documentation           PMP_C-ESM-EP.py  set_available_period_ts_clim.py
comparison_example     main_C-ESM-EP.py        README.md        setenv_C-ESM-EP.sh
custom_plot_params.py  ORCHIDEE_eval_20180130  run_C-ESM-EP.py  share
(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git>
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(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git>
(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git> cd ORCHIDEE_eval_20180130/
(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git/ORCHIDEE_eval_20180130> ls
AtlasExplorer           climaf.log         job_PMP_C-ESM-EP.sh  Monsoons
Atmosphere_Surface      datasets_setup.py  last.out             ORCHIDEE
cesmep_atlas_style_css  job_C-ESM-EP.sh    MainTimeSeries       ParallelCoordinates_Atmosphere
(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git/ORCHIDEE_eval_20180130>
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(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git/ORCHIDEE_eval_20180130>
```

In my working directory on /home

Adding your simulations

datasets_setup.py

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(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git> ls
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comparison_example     main_C-ESM-EP.py        README.md        setenv_C-ESM-EP.sh
custom_plot_params.py  ORCHIDEE_eval_20180130  run_C-ESM-EP.py  share
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(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git> cd ORCHIDEE_eval_20180130/
(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git/ORCHIDEE_eval_20180130> ls
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Atmosphere_Surface      datasets_setup.py  last.out             ORCHIDEE
cesmep_atlas_style_css  job_C-ESM-EP.sh    MainTimeSeries       ParallelCoordinates_Atmosphere
(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git/ORCHIDEE_eval_20180130>
(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git/ORCHIDEE_eval_20180130>
(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git/ORCHIDEE_eval_20180130>
(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git/ORCHIDEE_eval_20180130>
(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git/ORCHIDEE_eval_20180130>
```

In my working directory on /home

Comparison directory: ORCHIDEE_eval_20180130

Adding your simulations

datasets_setup.py

2. jservon@ciclad-ng:~/C-ESM-EP/git/ORCHIDEE_eval_20180130 (ssh)

```
(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git>
(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git>
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(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git>
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(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git>
(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git> ls
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comparison_example     main_C-ESM-EP.py        README.md        setenv_C-ESM-EP.sh
custom_plot_params.py  ORCHIDEE_eval_20180130  run_C-ESM-EP.py  share
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(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git>
(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git>
(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git> cd ORCHIDEE_eval_20180130/
(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git/ORCHIDEE_eval_20180130> ls
AtlasExplorer           climaf.log         job_PMP_C-ESM-EP.sh  Monsoons
Atmosphere_Surface      datasets_setup.py  last.out             ORCHIDEE
cesmep_atlas_style_css  job_C-ESM-EP.sh    MainTimeSeries       ParallelCoordinates_Atmosphere
(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git/ORCHIDEE_eval_20180130>
(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git/ORCHIDEE_eval_20180130>
(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git/ORCHIDEE_eval_20180130>
(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git/ORCHIDEE_eval_20180130>
(PMP_nightly-nox) jservon@ciclad-ng:~/C-ESM-EP/git/ORCHIDEE_eval_20180130>
```

In my working directory on /home

Comparison directory: ORCHIDEE_eval_20180130

Vi datasets_setup.py

Adding your simulations

the python list ‘models’

```
models = [

      dict(project='IGCM_OUT', login='p86fair', simulation='CM6014-pd-splith-01', color='green' ),
      dict(project='IGCM_OUT', login='p86maf', simulation='CM6014-pd-split-D-01', color='red'),
      dict(project='IGCM_OUT', login='p86maf', simulation='CM6014-pd-ttop-01', color='blue'),

      dict(project='IGCM_OUT', login='p86ghatt', model='LMDZOR', status='PROD',
           experiment='ref4438', simulation='CL5.4438.L6010.ref'),
      dict(project='IGCM_OUT', login='p86ghatt', model='LMDZOR', status='PROD',
           experiment='ref4438', simulation='CL5.4438.L6010.alt1'),

      dict(project='IGCM_OUT', login='p529bast', model='OL2', status='PROD',
           experiment='ref4783', simulation='FG2.4783.v3'),

]

# -- Provide a set of common keys to the elements of models
# ------------------------------------------------------------------------ >
common_keys = dict(
           root='/ccc/store/cont003/thredds', login='*',
           model='IPSLCM6',
           frequency='monthly',
           clim_period='last_10Y',
           ts_period='full',
           )
```

Definition of a project

Demystify the CliMAF project

Definition of a project: example with an ORCHIDEE simulation (same pattern as 'IGCM_OUT' project):

```
# -- Define the path/filename pattern and include attributes

#/ccc/store/cont003/thredds/p529bast/IGCM_OUT/OL2/PROD/ref4783/FG3.4783.v4/SRF/Analyse/TS_MO/FG3.4783.v4_19790101_20091231_1M_tair.nc

pattern='${root}/${login}/IGCM_OUT/${model}/${status}/${experiment}/${simulation}/*/${OUT}/${frequency}/${simulation}_YYYYMM_YYYYMM_${frequency}_${variable}.nc'

# -- Declare that the project 'ORCHIDEE' takes the following attributes
cproject('ORCHIDEE', ('frequency','monthly'), 'root', 'login', 'model', 'status', 'experiment', ensemble=['model','simulation'],separator='%')

# -- Finalize the 'ORCHIDEE' project
dataloc(project='ORCHIDEE', organization='generic', url=pattern)
```

Add your own project

Example provided in datasets_setup

```
# -- Declare a 'CMIP5_bis' CliMAF project (a replicate of the CMIP5 project)
# ------------------------------------------------------------------------ >
cproject('CMIP5_bis', ('frequency','monthly'), 'model', 'realm', 'table', 'experiment', ensemble=['model','simulation'],
separator='%')
# --> systematic arguments = simulation, frequency, variable
# -- Set the aliases for the frequency
cfreqs('CMIP5_bis', {'monthly':'mon'})
# -- Set default values
cdef('simulation'  , 'r1i1p1'       , project='CMIP5_bis')
cdef('experiment'  , 'historical'   , project='CMIP5_bis')
cdef('table'       , '*'            , project='CMIP5_bis')
cdef('realm'       , '*'            , project='CMIP5_bis')
# -- Define the pattern
pattern="/prodigfs/project/CMIP5/output/*/${model}/${experiment}/${frequency}/${realm}/${table}/${simulation}/latest/${v
ariable}/${variable}_${table}_${model}_${experiment}_${simulation}_YYYYMM-YYYYMM.nc"
# --> Note that the YYYYMM-YYYYMM string means that the period is described in the filename and that CliMAF can
# --> perform period selection among the files it found in the directory (can be YYYY, YYYYMM, YYYYMMDD).
# --> You can use an argument like ${years} instead if you just want to do string matching (no smart period selection)

# -- call the dataloc CliMAF function
dataloc(project='CMIP5_bis', organization='generic', url=pattern)
# ------------------------------------------------------------------------ >
```

Today's scientific content

control from ORCHIDEE/params_ORCHIDEE.py

We produce maps of:

- seasonal, annual, monthly averages
- Climatology, biases and model-model differences (difference with a reference simulation)
- Possible to have multiple references

Energy budget:

- 'fluxlat','fluxsens','albvis','albnir','tair','swdown','lwdown'
- obs/reference = EnsembleLEcor (fluxlat), EnsembleHcor (fluxsens), Modis (albvis, albnir)

Water budget:

- 'evapnu','subli','evap','runoff','drainage','snow'
- obs/reference = Modis (snow)

Carbon budget:

- 'gpptot', 'lai', 'GPP_treeFracPrimDec', 'GPP_treeFracPrimEver', 'GPP_c3PftFrac', 'GPP_c4PftFrac', 'total_soil_carb_PFT_tot', 'maint_resp_PFT_2','growth_resp_PFT_2','hetero_resp_PFT_2','auto_resp_PFT_2'
- obs/reference = EnsembleGPP (gpptot), GIMM3G (lai)

Today's scientific content

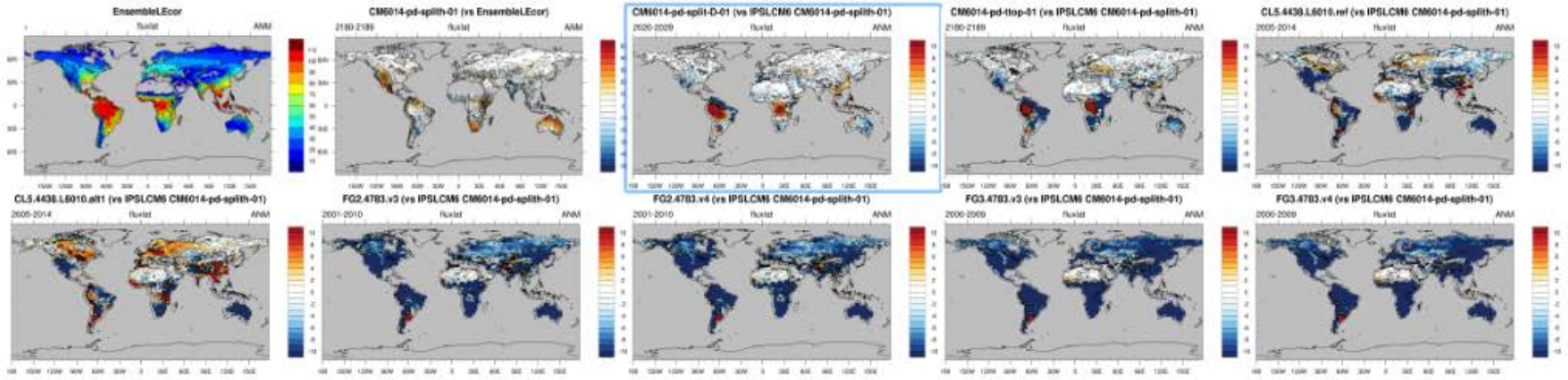
control from ORCHIDEE/params_ORCHIDEE.py

Sécurisé | https://vesg.ipsl.upmc.fr/thredds/fileServer/IPSLFS/jservon/C-ESM-EP/ORCHIDEE_eval_20180130_jservon/ORCH...

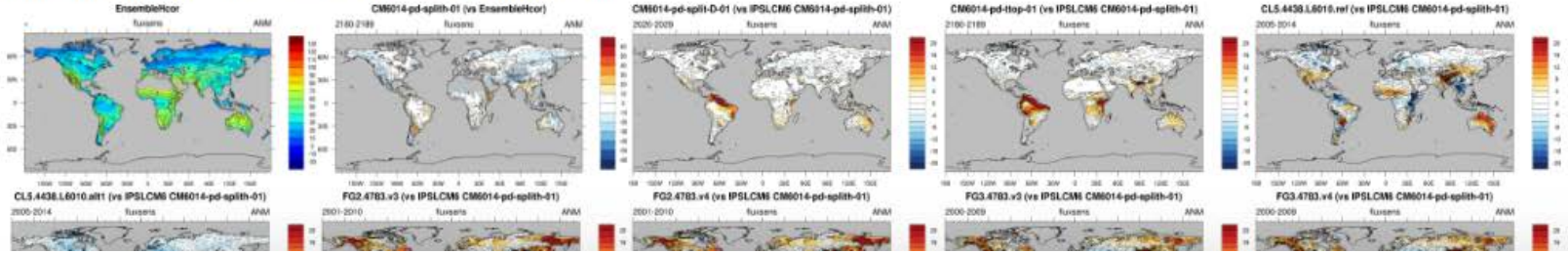
ORCHIDEE

ORCHIDEE Energy Budget, Climato OBS, Bias and model-model differences

- Latent Heat Flux (fluxlat) ; season = ANM ; REF = EnsembleLEcor



- Sensible Heat Flux (fluxsens) ; season = ANM ; REF = EnsembleHcor



https://vesg.ipsl.upmc.fr/thredds/fileServer/IPSLFS/jservon/C-ESM-EP/ORCHIDEE_eval_20180130_jservon/ORCHIDEE/atlas_ORCHIDEE_ORCHIDEE_eval_20180130.html

Work in progress and perspectives

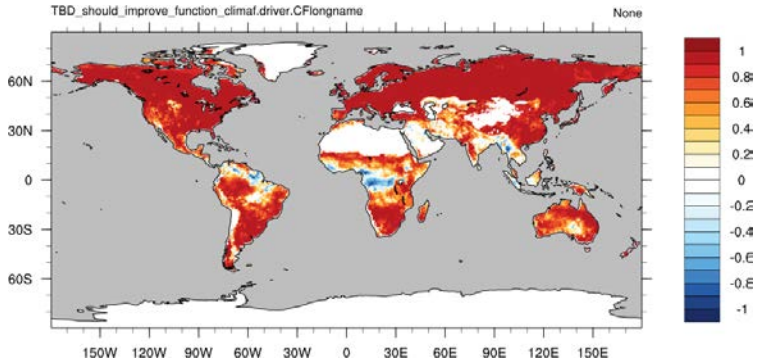
in the ORCHIDEE C-ESM-EP atlas

We can easily keep adding:

- New references/obs to extend the number of variables
- ‘Derived variables’ = a variable that is a combination of others, selection on PFTs…

In progress:

diagnostics developed by N. Vuichard (correlation maps on the annual cycle)

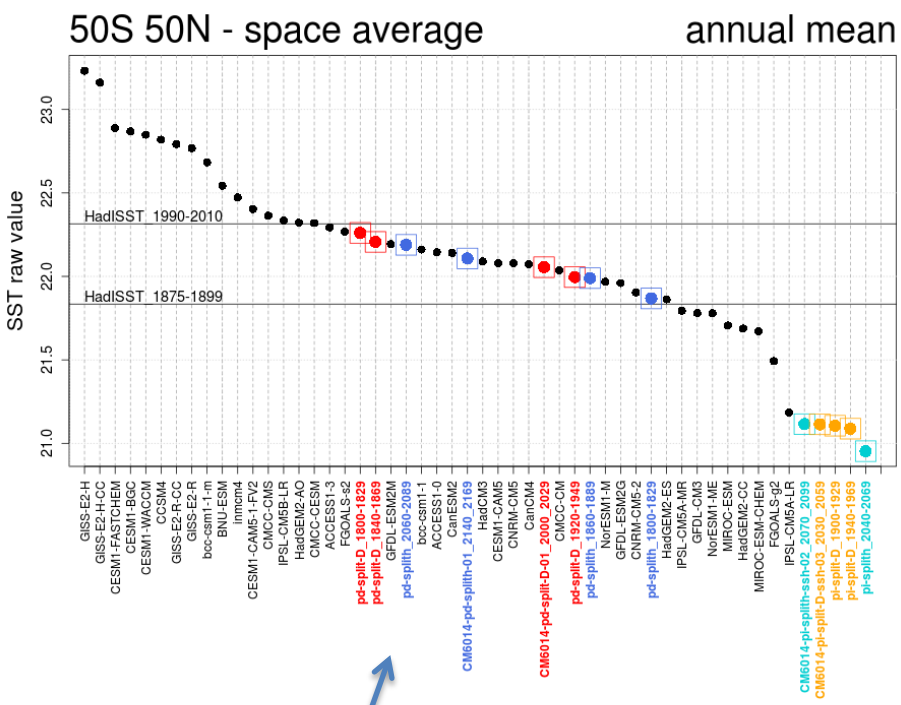


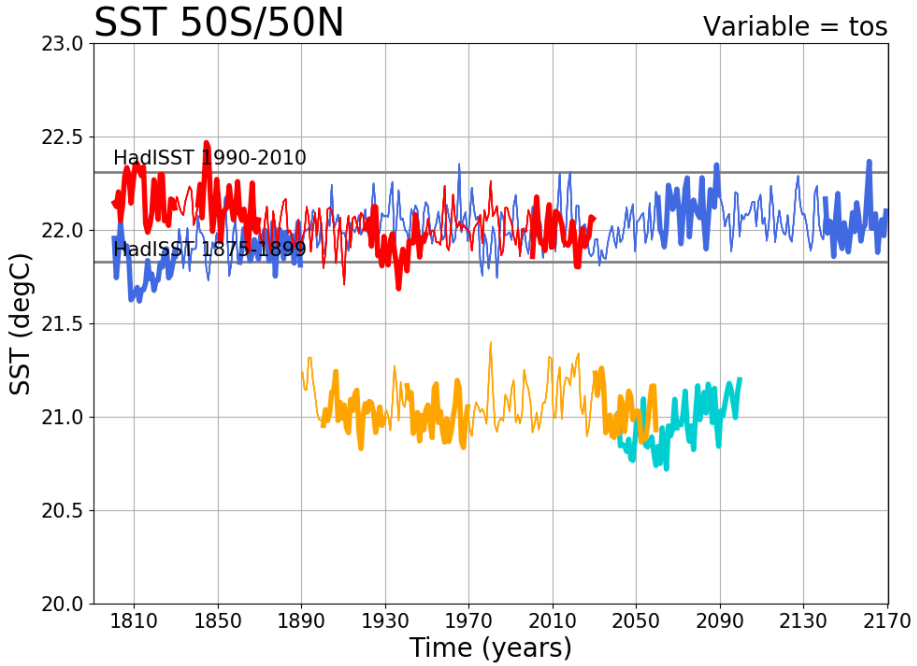
Perspectives/possibilities:

metrics, time series of the main variables (with highlight of the period used to compute the climatologies), new diagnostic scripts (example of O. Torres)

Work in progress and possibilities

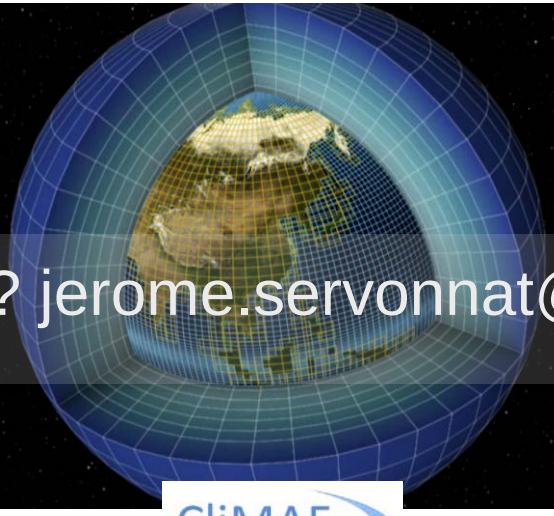
in the ORCHIDEE C-ESM-EP atlas





R script

Python script



Questions? jerome.servonnat@lsce.ipsl.fr

CliMAF
Sharing – Simplifying – Optimizing

The CliMAF Earth System Model Evaluation Platform, 2017

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Beta-testers:
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